SOLVAY
SODA ASH JOINT VENTURE

July 23, 1997

Lee Gribovicz
WDEQ-Air Quality Division
250 Lincoln St.
Lander, WY 82520

RE: AP-W77 BACT Analysis Supplement

Dear Lee:

Following is a Best Available Control Technology (BACT) Analysis for controlling VOC emissions with a Wet Electrostatic Precipitator (WESP) and for controlling CO emissions with an oxidation catalyst from AQD #80, the proposed Solvay Soda Ash Joint Venture expansion calciner exhaust.

BACT Analysis for Controlling VOC Emissions from AQD #80 - Trona Calciner Utilizing a Wet Electrostatic Precipitator:

The Wet Electrostatic Precipitator (WESP) is designed to collect ultrafine particles or liquid droplets. It is not designed to control gaseous emissions, such as the VOCs found in a trona calciner exhaust stream. Some of the reasons a WESP is not technically feasible for control of volatile organic compounds (VOCs) from a trona calciner exhaust are noted below:

1. Many of the VOC compounds emitted from the calciner have boiling points well below the WESP's operating temperature of 110 to 120° F. For instance, 1,3 butadiene has a boiling point of -4.4° C (24° F). If passed through a WESP, these VOCs would remain in a gaseous stage and would not be captured. The WESP is not a condenser nor a high gas-to-liquid contactor.

2. Many of the VOC compounds found in the calciner exhaust stack are not soluble in water, they are only soluble in other organic solutions. Water is typically used in the WESP.

3. If the VOCs could be captured by a WESP, the condensate would be sent either to the tailings evaporation pond or pass into the process liquor with the recovered carbonates. If passed to the tailings pond, the VOCs would again convert to the

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gaseous state and be emitted to the atmosphere at the pond. If passed through the process, the VOCs would be emitted from the dryer stack exhaust.

4. The trona (sodium sesquicarbonate, chemical formula $Na_2CO_3 \bullet NaHCO_3 \bullet 2H_2O$) is soluble in water and when dissolved, raises the pH of the solution. Calcium and magnesium carbonates ($CaCO_3$ and $MgCO_3$) are precipitated when trona is dissolved in water as the pH rises. If a trona solution with $CaCO_3$ and $MgCO_3$ impurities were passed through a WESP, these carbonate compounds would precipitate and scale the electrodes and collecting plates. A water wash would not be effective in cleaning the unit. The WESP would become inoperable, due to electrical short circuiting at the points of scale deposition.

5. The particulate inlet grain loading from the proposed calciner (AQD #80) to the pollution control unit can be over 100,000 pounds (50 tons) of trona dust per hour. The WESP is not designed to be used in high inlet grain loading processes, such as the calciner exhaust.

6. The typical design of the WESP requires 2-6 gph of water per 1000 acfm. The proposed calciner (AQD #80) will have an air flow of 264,000 acfm. At this rate, between 528 and 1,584 gallons of water would be required, yet the 100,000 pounds per hour of dust to be treated from the calciner would require approximately 28,000 gallons to dissolve the dust, more than 17 times the amount of water the WESP is designed to handle. If the design amounts were used, the undissolved, wetted trona would quickly plug the WESP.

   Attached is a letter from FLS milijø Group, a vendor that has installed over 100 WESP units, further explaining the WESP is not effective as a VOC control device for Solvay Soda Ash Joint Venture's proposed calciner exhaust.

   It is apparent from our research that neither a WESP nor a dry ESP are suitable to reduce VOC emissions from the proposed calciner exhaust (AQD #80). We have been unable to discover technology that is applicable to removing the very low concentrations of VOCs from the hot, large exhaust volumes emitted from a trona calciner.

   Minimizing VOC emissions from a trona calciner exhaust is accomplished by efficient operation of the units, with a series of lifters, dams, and cells in the calciner. The gradual heating lends to complete calcination and minimizes the high heat zones that contribute to volatilizing organics in the ore. The use of the existing design of the calciner system is proposed as BACT for VOC control.

BACT Analysis for Controlling CO Emissions from AQD #80 - Trona Calciner Utilizing Oxidation Catalysts

Carbon monoxide (CO) is generated as a result of incomplete combustion of fuel. CO emissions due to combustion of natural gas are controlled by the design and operation of the Magna Flame LEX Burner that will be installed on the proposed expansion calciner, AQD #80.

In the calciner, trona ore is heated to convert it to soda ash (Na_2CO_3), by liberating carbon dioxide (CO_2) and water (H_2O). CO is released as organics inherent in the ore are incompletely oxidized. To reduce CO emissions beyond combustion control, an oxidation catalyst is a practiced choice. Exhaust gases are passed over a catalyst bed where excess air oxidizes the carbon monoxide (CO) to carbon dioxide (CO_2). For effective operation, temperatures across the oxidation catalyst bed should be in the 900 - 1,000° F range. Typically, the oxidation catalyst can achieve CO removal efficiencies up to 90 percent. To conserve energy and minimize other emissions, the calciner is operated at the lowest temperature required to convert the trona to soda ash. The calciner exhaust temperature of 300° F would not allow effective operation of an oxidative catalyst system. At lower than optimal temperatures, CO oxidation is less effective and more catalyst is required. resulting in a larger pressure drop and increasing capital and operating costs.

The proposed calciner will have a particulate emission grain loading after the ESP of 0.015 gr/dscf, with additional particulate emitted in surges during start-ups and shut-downs of the unit. It is expected that the particulate matter in the gas stream would contribute to blinding/masking of the catalyst by coating active surfaces. At concentrations of 0.015 gr/dscf, a soot-blower type system utilizing compressed air and/or a chemical wash, along with frequent shutdowns, to clean the system and restore CO removal would be required.

There are no known installations of CO oxidation catalysts on calciner operations. The low temperature of the calciner exhaust would render a CO oxidation catalyst system inefficient, if not inoperable. Furthermore, the particulate grain loading of the exhaust may cause blinding and require excessive maintenance be performed on the catalyst system to keep it operational. Therefore, controlling CO emissions with an oxidation catalyst is not technically feasible.

The present design of the burner may help to control CO emissions from oxidation of the trona ore. The Magna Flame LEX Burner employs a relatively short flame, thereby minimizing the flame/trona interface. Furthermore, the flame temperature is minimized to achieve low NO_X emissions. These two operating parameters of the proposed burner system may help reduce the CO emissions from the trona. The use of the existing design of the calciner burner system is proposed as BACT for CO control.

If you have any questions concerning this BACT supplement, do not hesitate to contact me at (307) 872-6571.

Sincerely,

Dolly A. Potter
Environmental Engineer

Enclosure

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July 11, 1997

Dolly Potter
Solvay Minerals, Inc.
P.O. Box 1167
Green River, Wyoming 82935

Subject: Wet Electrostatic Precipitator
Process Applications

Dear Ms. Potter:

FLS miljø has considered your request to evaluate the suitability of wet electrostatic precipitators for the control of VOC emissions.

We do not believe this is a technically acceptable solution and provide the following comments.

Wet Electrostatic Precipitator Technology

Wet ESPs are used to collect particles, liquid droplets, and combinations of the two from gas streams, and operate on the principle of electrical charging. It should be noted that electrostatic precipitators cannot separate gases as such, only the particles or droplets entrained in the gases.

The gases are passed through an intense electrical field set up between electrodes of opposite polarity. The discharge electrodes, so called because of the corona discharge which results from the application of high voltage, impart a negative charge to the particles. These particles are then attracted to the collector electrodes which are positive with respect to the discharge electrodes and are grounded. So far, the principles are similar for both wet and dry ESPs.

However, the fundamental difference is that the wet unit operates on saturated gas streams, i.e., at gas temperatures equal to or below the water dew prohibit of the gas stream, whereas dry units operate above the water dew point and up to several hundred degrees.

In wet units the charged particles or droplets are captured on the collector surface and then removed either by an intermittent wash down system using water to remove the deposits, or for some processes, continuous irrigation on the collectors themselves can be supplied. For certain types of acid mist collection, the acid itself forms the liquid on the collectors and supplementary irrigation is not required.

All the liquids flow down the collector sheets into a sump at the base of the unit from where they are extracted.

The hot gases, after passing through a wet ESP, are saturated with water vapor. If they are to be discharged direct to atmosphere a visible plume is to be expected.

Typical Wet ESP Applications

Wet ESPs are used in certain industrial applications having difficult to handle particulates, including:

- Fine particulate
- Sticky particles
- Very low emission applications
- Acid mist collection

Typical industries with these applications include for example wood products, blast furnaces, chemical incinerators, metallurgical processes, and acid mist cleanup downstream of wet scrubber systems.

What Wet ESPs Cannot Do

Wet ESPs cannot be used as absorption vessels for control of gaseous emissions. Absorption processes are designed on the principle of contacting gases with extremely high surface areas of droplets to achieve efficient absorption. Typically this is done in spray towers and packed towers.

The wet ESP does not achieve a high degree of contact between gases and irrigation water. This is because the particles in the gas are separated by the electrostatic forces which cause the particles to drift to the collecting surface independently of the gas. In fact, as far as absorption processes are concerned, there is really no mixing at all of gas and irrigation water.

The use of intermittent spray irrigation cannot be adapted to the absorption process inside the precipitator because any such actions will overload the precipitator electrical system which will be trying to collect the droplets. For this reason irrigation sprays are only turned on intermittently and in some cases there is even a provision to back off on the electric charging during the spray period so as to avoid overload.

Comments on Application for VOC Control

FLS miljø would rule out the use of wet electrostatic precipitators for the control of VOC emissions for soda ash applications.

First, the VOCs will simply pass through the precipitator as gaseous vapor and will not be treated by the electrostatic collection process.

Second, if there were some process modification which could absorb the VOCs into droplets upstream, the wet ESP would then have another operating problem in collecting the accompanying calcium/magnesium-based particulate matter in the irrigation stream on the collector sheets. This is because these compounds normally cause the buildup of hard scale in water recycle systems and any scale formation on the collectors would be fatal to the equipment operation.

The collectors are carefully designed with smooth surfaces so that the irrigation film is uniform across the plate with no dry spots. Any dry spots, which would occur immediately in areas of scale formation, will receive direct electric arcing from the discharge electrodes and be damaged.

Assuming one approach to control scaling would be to run at very high dilution levels, we trust this would lead to water rates that would be prohibitive to the overall process.

Sincerely,

Charles Leivo

Charles Leivo
Sales manager
Phone 281 539 3420

Copy

Reid Baumgartner
FLS miljø Representative
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